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SEALED FILM LUG LINERS for PACKING BING CHERRIES

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SUMMARY

During the season of 1955, Mylar and polyethylene films were used as sealed film box liners for the regular 15-pound standard wooden cherry lug to test their effect on appearance of cherries. Bing cherries in such packages were held at 36° F. for various intervals to simulate express and freight shipment and then kept at 65° for 2 days to simulate the marketing period at the terminal market. In some instances the film liners were perforated prior to holding at 65° ; in others the film liners remained sealed.

Mylar film required perforation at both 36° and 65° F. to prevent impairment of flavor because of very high concentrations of CO_2 and low concentrations of O_2 in the sealed packages.

Polyethylene box liners for cherries did not require perforation at 36°; concentrations of 7 to 9 percent of CO_2 and 3 to 5 percent oxygen were obtained under these conditions. Perforation of the film was necessary to prevent injury to the fruit at 65°. In sealed film box liners, concentrations of 18 percent CO_2 and 1 percent O_2 were obtained after 2 days at 65°.

Decay was markedly reduced and stem freshness and fruit brightness were preserved by packaging cherries in sealed polyethylene film box liners. Approximately 15 carloads of cherries were packaged, shipped, and marketed successfully in poly lug liners in 1955.

SEALED FILM LUG LINERS FOR PACKING BING CHERRIES

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Fresh appearance of sweet cherries and of their stems is of great importance in marketing this perishable fruit. While most of the sweet cherry crop is still marketed as a double row face and fill pack, consumer acceptance of high quality fruit in the loose or "jumble" pack and in plastic bags is increasing. High labor costs and the desire to improve the appearance and condition of the fruit have stimulated commercial interest in the development of new packaging methods for sweet cherries.

Past studies (2, 4, 7)[2] have shown that many types of sealed synthetic films are not suited for packaging cherries even when they are held at cold storage temperatures. Of the many films tested, sealed Pliofilm 80FM1 and polyethylene have shown promise as packaging media to preserve the appearance and to reduce decay in sweet cherries. Improvement of fruit condition is accomplished chiefly through reducing moisture loss from the fruit and the accumulation, at cold storage temperatures, of tolerable amounts of carbon dioxide. Both respiration and decay have been reduced in sweet cherries by the addition of carbon dioxide (1, 5) to the air surrounding the fruit; its bright red color has also been somewhat preserved by this treatment. The use of solid carbon dioxide (dry ice) in refrigerator car shipments of cherries (6) is, under certain conditions, now standard commercial practice.

The value of sealed polyethylene film box liners has been established for pears and certain varieties of apples (3, 4); similar liners may be valuable in preserving the appearance and condition of sweet cherries. This report presents information on the use of Mylar and polyethylene films as sealed liners for Bing cherries packed in the standard wooden 15-pound cherry lug.

MATERIAL AND METHODS

Source and Handling of Fruit

Approximately 300 pounds of well-matured Bing cherries were harvested at Wenatchee, Wash., on July 11 and held overnight at 36° F. This fruit was carefully sorted the following morning, and placed loose in 12-1/2 pound lots in standard wooden 15-pound cherry lugs. The lugs were lined with either plain paper liners or with plastic bag liners (16" x 10" x 19") of 1 mil Mylar or 1.5 mil polyethylene. These films were sealed immediately following packaging of the fruit. The lugs were then stored at 36° F.

Some of these test packages were held at 36° F. for 5 days and some for 10 days to simulate express and freight shipments, respectively. In each case the fruit was also observed after 2 additional days at 65° which corresponds to retail handling.

Other test packages were held at 31° for 15 and 23 days before being placed under simulated express and retail handling conditions (5 days 36°, 2 days 65°). This experiment was made to determine the feasibility of distributing commercial cherry shipments over a longer time to avoid terminal market gluts.

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[2] Underscored figures in parentheses refer to Literature Cited, page 8 .

Observations on the Fruit

Carbon dioxide and oxygen, in the atmosphere surrounding the test fruit in the sealed film liners, were measured with a Hays gas analyzer and a Beckman Model D oxygen analyzer, respectively. A random sample of 60 cherries from each test treatment was taken for precise objective determination of fruit firmness and stem thickness.

Fruit firmness at 75° F. was registered in grams on a Fisher Direct-Reading balance by placing the cherry between the balance pan and a special disc in the chuck of a drill press. The drill press arm was calibrated to give a thrust of one-eighth inch. The assembled apparatus is shown in figure 1. Thickness of the stem at mid-section was measured with an Ames Thickness Gauge No. 25 calibrated in 0.001 inch. Moisture content of the cherry stems was determined by drying the clipped stems to constant weight in a vacuum oven at 86° F. The stems and fruit in the experimental lots were inspected visually. Dessert quality was evaluated for taste by a panel of 3 people.

Figure 1.--The direct-reading balance and drill press assembly for measuring the firmness of Bing cherries.

RESULTS

Gas Concentrations in Sealed Packages

Mylar was found to be too impervious to CO_2 and O_2 to permit its use as a sealed film liner for cherries, even for periods as short as 5 days at 36° F. (table 1). Within the package, oxygen was reduced to less than 1 percent and carbon dioxide had accumulated to 20.8 percent; flavor of the fruit was definitely impaired. When packages remained sealed for an additional 2 days at 65° (simulated retail handling), CO_2 concentrations of 50 percent developed; the fruit was inedible and had developed a foul odor. Mylar film must be perforated when used to package sweet cherries.

The data in table 1 show that polyethylene can be safely used as a sealed film liner for cherries during extended periods of storage at 31° and 36° F. A maximum concentration of 8.5 percent CO_2 and a minimum value of 2 percent O_2 were found in test packages held at 36° for 10 days, or during storage at 31° for 15 days followed by an additional 5 days at 36°. The dessert quality of these lots of fruit was acceptable when sampled <u>immediately</u> following cold storage.

However, on removal from cold storage, it is mandatory to perforate the sealed polyethylene film liner to avoid damage to the dessert quality of the cherries. Even after only 5 days at 36° F. and 2 days at 65°, sufficient amounts of CO_2 and O_2 were present to impair the dessert quality of the fruit if the sealed films were not opened when the fruit was removed from cold storage. (Table 1.)

TABLE 1.--Response of Bing cherries to packaging in sealed Mylar and polyethylene sealed lug liners

Storage and liner	Gas concentration in package		Loss in weight of fruit	Firmness of fruit	Thickness of stem (diameter)	Decay	Appearance of stems	Appearance and condition of fruit
	CO_2	O_2						
	Percent	*Percent*	*Percent*	*Grams*	*Thousandths of an inch*	*Percent*		
None	-	-	-	[1] 195.8	[2] 46.3	-	Green, turgid.	Bright red color, excellent dessert.
5 days at 30° F.								
Standard paper	-	-	1.5	176.8	40.1	0	Tips dry, some browning.	Mahogany color, excellent dessert.
Sealed polyethylene	7.4	5.7	0	187.9	47.9	0	Fresher than check lot.	Not as dark colored as check, excellent dessert.
Sealed Mylar	20.8	.5	0	189.3	45.6	0	Same as in polyethylene.	Impaired flavor--poor dessert.
2 additional days at 65°								
Standard paper	-	-	-	168.7	36.7	3.2	Mostly dry and brown.	Dark mahogany color, excellent dessert.
Sealed polyethylene	16.0	.5	-	192.4	44.4	.9	More turgid and green than check.	Impaired flavor--poor dessert.
Opened polyethylene	-	-	-	178.1	39.1	1.8	Same as in sealed polyethylene.	Light mahogany color--excellent dessert.
Sealed Mylar	50.0	.5	-	188.8	39.5	2.2	Same as in polyethylene.	Foul odor--inedible.
Opened Mylar	-	-	-	182.3	38.9	1.7	Same as in poly.	Impaired flavor--poor dessert.
10 days at 36°								
Standard paper	-	-	2.3	[3] 180.8	[4] 41.2	1.7	Tips brown, dry.	Dark color, some shrivel--excellent dessert.
Sealed polyethylene	7.6	3.2	0	193.8	45.9	0	Fresher and less brown than check.	Bright color, no shrivel, excellent dessert, mild flavor.
2 additional days at 65°								
Standard paper	-	-	2.6	160.2	36.0	3.3	Brown, dry.	Very dark color, some shrivel, good flavor.
Sealed polyethylene	17.4	1.0	.3	-	45.6	1.3	Fresher, greener than check.	Bright color, no shrivel, impaired flavor--poor dessert.
Opened polyethylene	-	-	1.3	176.1	41.9	.8	Same as in sealed film.	Color and condition better than check, very good flavor.
15 days at 31°								
5 additional days at 36°								
Standard paper	-	-	2.1	[5] 173.6	[6] 37.5	3.5	Upper half brown, dry, thin.	Dull, dark soft shoulder, shrivel "aged" look, good flavor.
Sealed polyethylene	8.5	2.0	.1	195.1	44.8	.7	Turgid, greener than check.	Much fresher looking than check, normal flavor, more tart than check.
2 additional days at 65°								
Standard paper	-	-	2.6	163.8	33.0	4.3	Severely browned, very dry.	Dull, soft, very "aged" look, mild to neutral flavor.
Opened polyethylene	-	-	1.5	184.8	40.2	2.0	Turgid, greener than check.	Brighter, fresher look and better dessert quality than check.
23 days at 31°								
5 additional days at 36°								
Standard paper	-	-	4.5	173.0	36.7	3.5	Dry, mostly brown, loose.	Dull, "aged" look, moderately shriveled, lack of varietal flavor, flat.
Sealed polyethylene	8.2	1.0	.3	191.2	43.6	.7	Turgid, fresher looking than check.	Much fresher appearance than check, tart flavor, slightly better than check.
2 additional days at 65°								
Standard paper	-	-	4.7	155.8	32.0	3.3	Brown, thin, dried.	Dull, shriveled, very poor looking, neutral flavor, poor to fair dessert.
Opened polyethylene	-	-	1.8	174.0	35.2	2.4	Brown, not as dry as check.	Firmer and brighter than check, impaired flavor, inedible.

[1] Least significant difference 9.3 at 1-percent level; 7.1 at 5-percent level.
[2] Least significant difference 2.6 at 1-percent level; 1.9 at 5-percent level.
[3] Least significant difference 9.1 at 1-percent level; 6.9 at 5-percent level.
[4] Least significant difference 2.5 at 1-percent level; 1.9 at 5-percent level.
[5] Least significant difference 10.9 at 1-percent level; 8.3 at 5-percent level.
[6] Least significant difference 2.2 at 1-percent level; 1.6 at 5-percent level.

Firmness of Fruit and Thickness of Stem

Objective precision tests were devised to measure the firmness of the sweet cherry and the thickness of its stem (turgidity) as influenced by packaging in sealed film liners. (Table 1.) Stem thickness and firmness of the Bing cherry were preserved to a significantly greater degree by packaging in film rather than in the standard paper lug liners. In most instances, the differences in firmness and stem diameter of cherries in film and in paper liners were highly significant even at the 1-percent level. Fruit stored for 10 days at 36° F. in sealed polyethylene film possessed a firmness and stem diameter little different from its original values at harvest while comparable fruit in paper lug liners lost 15 grams in firmness and 0.005 inch in stem thickness during a similar interval. These differences in stem thickness as related to packaging medium are reflected in the actual moisture content of the stems. The data show that even after 2 days at room temperature, the stems of fruit in the lug with the opened poly liner had a higher moisture content than did similar fruit in paper liners at 36° F. sampled 2 days earlier. The stems of the fruit packaged in poly film had about 24 percent more moisture after 2 days at 65° than did comparable stems of check fruit in standard paper liners.

The moisture content of the stems of Bing cherries in 15-pound lugs was as follows:

Storage and liner	Percent
10 days at 36° F.	
Standard paper liner	59.4
Sealed polyethylene liner	65.6
2 additional days at 65°	
Standard paper liner	48.9
Opened polyethylene liner	60.6

Decay, Weight loss, and Appearance

Decay was greatly reduced at 36° F. by packaging cherries in sealed film rather than in paper liners. This reduction in decay was apparent even at simulated retail temperatures when the film liners were perforated or opened. These results indicate a beneficial residual effect from previous gas storage atmospheres within the sealed film box liners. Published results (1) have shown that decay in sweet cherries was retarded and reduced by increased amounts of carbon dioxide in the air surrounding the fruit.

Loss in weight of the fruit was also reduced to a marked degree by packaging in sealed film liners. The data in table 1 show that such losses at 31° and 36° F. were practically nil even after 23 days of storage. Moisture loss, during simulated retail handling, was also less in the fruit held in the perforated or opened film liners than when packaged in paper-lined lugs. Visible shrivel in the sweet cherry becomes apparent with only a small (approximately 2 percent) loss in moisture. The appearance of the fruit is greatly impaired by even slight amounts of shrivel. While dessert quality is not generally lowered by some moisture loss, salability of the fruit is directly related to its fresh, turgid appearance.

Data in table 1 show that the greenness, freshness, and turgidity of the cherry stems was preserved to a greater degree in film liners than in paper liners. Cherry stems for instance, were quite dry and brown in paper liners after 10 days at 36° F.; comparable fruit stems in polyethylene film liners appeared less discolored, more turgid, and fresh looking. This differential appearance increases with the length of time in storage. It is not the intent of the authors to imply that stem browning can be prevented by packaging cherries in film liners, but this method will retard the severity of browning, and by preservation of the turgidity of the stem, create the impression of less aging and a fresher appearance than stems in the conventional pack.

The bright color of the fruit and its freedom from shrivel, especially around the crown, were both much more pronounced in cherries packaged in "poly" than in those in paper liners. Aging of the sweet cherry is often associated with the development of a "pebbly" appearance of the skin, probably a primary result of moisture loss. This condition was also generally retarded by packaging in polyethylene film.

Dessert Quality

The data in table 1 show that the dessert quality of sweet cherries was definitely impaired whenever they were enclosed in Mylar sealed film liner. Polyethylene can be used with safety if the seal is broken upon removal from cold storage. Failure to perforate the film at this time caused impairment of flavor and poor dessert quality of the fruit even after only 5 days at 36° F. and 2 days at room temperature (simulated express and retail handling). When the cold storage period was lengthened to 10 and 15 days in the sealed film prior to perforation at room temperatures, the dessert quality of these cherries was superior to comparable fruit in the conventional paper liner. Therefore, under extremely unfavorable market conditions cherries can be held in cold storage in sealed poly liners for about 2 weeks and still be a fairly acceptable product, although this fruit would not be as desirable as that shipped promptly. Speed in transport between producer and consumer is still the secret in handling a commodity as perishable as sweet cherries. Cherries in these tests could not be held in cold storage for 23 days in poly liners and then be marketed without critical impairment of appearance and dessert quality.

COMMERCIAL EXPERIENCE WITH CHERRIES IN POLY LINERS

The Wenatchee shipper who pioneered the commercial use of polyethylene box liners for pears also successfully made volume carlot shipments of cherries in poly-lined standard wooden lugs during the past season. Both double row faced and loose fruit were packaged in film.

The film liners were first placed in the lugs, (fig. 2), and then the fruit was packed in them in the conventional manner (fig. 4 and cover). Air was partially exhausted from the pack to facilitate lidding, and film closure was made by twist-seal. This film closure procedure was simplified during the latter part of the packing season when it was found that a generous overlap-fold of the film (fig. 4), between the chipboard top facing and the corrugated cover pad, effected an airtight closure comparable to the twist seal. Partial removal of the air became unnecessary as the folded film was held clear of the lidding area by tape (fig. 4).

Figure 2. --Placing polyethylene bag liners in cherry lugs. (Photo courtesy Wooden Box Institute, San Francisco, Calif.)

Modified atmospheres were rapidly established in the poly packs of fruit. This not only eliminated the need for solid carbon dioxide (dry ice) in carloads of cherries but also reduced the hazards of shipment by freight. Appearance of fruit in "poly" liners from freight shipments in many instances compared favorably with express shipments in conventional pack. Most of the commercial carload shipments of poly-pack cherries moved via freight during the 1955 season. The film liner was perforated upon unloading.

Figure 3. --Film-packed lugs of cherries moving through the packing plant and ready to be sealed and lidded. (Photo courtesy Wooden Box Institute, San Francisco, Calif.).

Figure 4. --A lug of cherries packed in polyethylene lug liner. The open box bottom shows the over-lap film seal.

Figure 5. --The receiver and auctioneer examining poly-packed Bing cherries at the New York auction. (Photo courtesy Wooden Box Institute, San Francisco, Calif.).

Poly-packed cherries were well received by the trade. Arrival reports stated that this fruit (figs. 5, 6) was "enthusiastically received by everyone who saw it." This enthusiasm was also reflected pricewise. Shipper interest indicates a more extended use of polyethylene lug liners for cherries during the coming season.

As a final word of caution, however, it must be emphasized again that perforation of the film liner is mandatory when cherries leave the refrigerator car or cold storage. Development of off-flavor and severe impairment of dessert quality will occur in non-perforated poly-packed lugs of cherries held at room temperature.

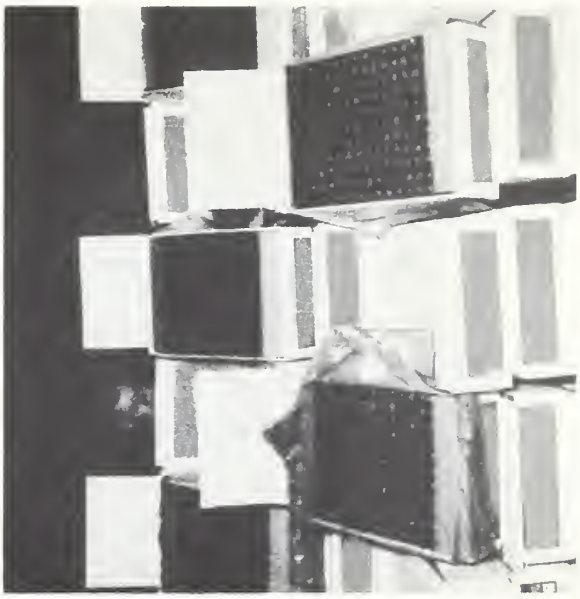

Figure 6.--Part of a carlot shipment of poly-packed Bing cherries as they appeared on the New York Auction floor. (Photo courtesy Wooden Box Institute, San Francisco, Calif.).

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